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Abigail Misfeldt
University of Nebraska-Lincoln

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TO WHAT EXTENT HAS THE RELATIONSHIP BETWEEN HUMANS AND RED
FOXES (*VULPES VULPES*) EVOLVED THROUGHOUT HISTORY?

By

Abigail Misfeldt

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Abstract

Red foxes are one of the few creatures able to adapt to living alongside humans as we have evolved. All humans and wildlife have some id of relationship, be it a friendly one or one of mutual hatred, or simply a neutral one. Through a systematic research review of legends, books, and journal articles, I mapped how humans and foxes have evolved together. First, the relationship between humans and foxes in a geographical manner by starting in Asia, moving to Australia and Tasmania, then Europe, Africa, finishing with North and South America. I will be analyzing all the information through a lens to either support or find the fault in a loop similar to the one described in, "*A conceptual framework to evaluate human-wildlife interactions within coupled human and natural systems*" (Morzillo et al). The loop being is an impact-based feedback loop and describes the ways human behavior is influenced by wildlife. In Asian cultures, the fox spirit can be a benevolent teacher or malevolent bloodthirsty monster. Foxes were first seen as deceitful in Europe with the introduction of Reynard the fox in 1148. The Pale Fox is the center of the Dogon creation myth in Africa. When the Europeans began colonizing Canada and the United States, the fur trade was the first ever contact between the Europeans and the Native People. Then a single domesticated line was created by a Russian geneticist. Today red foxes have been one of the few creatures able to adapt to living in large cities such as Paris, Toronto, and Los Angeles. The original question is, to what extent has the relationship between humans and foxes evolved? The uncomplicated answer...substantially.

Introduction

The red foxes (*Vulpes vulpes*) is the largest species of true fox and one of the most widely distributed carnivores in the world. Their origin is mostly unknown, as researchers are unable to pinpoint exactly where the red fox came from. Many believe they are native to the mountainous regions of North America, but others have said they came from Europe as red foxes were not common on the East coast until the mid-1800s (Statham 2012). Red foxes were introduced to Australia in 19th century and adapted very well to the new environment, quickly becoming a highly effective predator. Whatever their native home is, they have been very successful in claiming territories all over the world. They have also been one of the few creatures that has been able to integrate themselves into human society.

History

Humans and foxes have had a long and evolving history. They often were folklore lessons, religious characters and mythical creatures. In Greek mythology the giant Teumessian fox was sent as a punishment by Dionysus to prey on the children of Thebes for a crime the people committed and was destined to never be caught (The Teumessian fox 2020). Witches in Celtic mythology were believed to take the form of foxes to steal from their neighbors (Monaghan 2004). The idea that the fox represents deceit comes from European folklore when Reynard the fox makes his debut in “Ysengrimus” in 1150 (Reynard The Fox 2007). In Asian folklore fox-spirits are known as huli jing in China, kumiho in Korea, kitsune in Japan and hồ tinh in Vietnam. In North America, foxes in Native American mythology are cunning tricksters and the constant companion to the coyote. A Menominee story teaches the fox is the untrustworthy friend of the wolf (Bastian 2004). Those, however, are all legends. Foxes and humans have a very real history with ups and downs.

Hunting

The earliest records of fox hunting were found in fourth century BC; done by Alexander the Great in 350 BC. A Greek philosopher believed in killing foxes because they were pests and distracted dogs from hunting rabbits. By 80 A.D., foxes were no longer considered pests, and rather “beasts of the chase.” In 1200 Edward the first had a pack of foxhounds, specifically trained to hunt foxes. At this point in history, foxhounds became more popular to hunt the foxes on the ground rather than using terriers to hunt them underground. By the Renaissance, hunting foxes was a noble sport done by groups of men on horseback and their hounds. Fox hunting reached its peak in Britain in the 1700’s.

Pests

Foxes weren’t only hunting trophies; they are crafty predators. They hunted confined livestock and often targeted lambs (Macdonald 1987). Lambs from smaller breeds were more vulnerable to predation than ones from larger, heavier breeds (Macdonald 1987). Twins are also targeted because ewes cannot effectively defend both lambs. Lambs born from ewes who had given birth for the first time were also more easily hunted than experienced ewes. Domestic rabbits and guinea pigs are easy prey if they are left outside alone. This problem is easily solved by leaving the rabbit or guinea pig in a rabbit hutch. In more urban settings, they live side-by-side with feral cats. In a confrontation between the two, cats are usually the victors (Macdonald

1987). Most foxes don't prey on cats and the two animals are competitors rather than predator-prey (Macdonald 1987). Red foxes and feral cats co-exist in one place, alongside humans.

Fur Trade

Fox pelts quickly became a popular item and were used for scarves, jackets, muffs and ornamental trimmings. Silver foxes were popularly used in capes. The silver foxes were the most popular, making them the most valuable to furriers (Francis 1906). Over 1,000 fox pelts were shipped from Canada and the United States to Great Britain. 500,000 were exported every year from Germany and Russia (Francis 1906). The foxes caught in Northern Alaska were the most valued because they had a silkier texture than any of the counterparts which gave them increased mobility.

Domestication

Despite looking like dogs, foxes should definitely not be tamed and kept as pets. That fact has never stopped people from trying to domesticate things they shouldn't. Wild foxes are simply unsuitable to keep in the home. Many people through the years have "adopted" fox kits they believe were abandoned by their mothers (Jones 2016). However, it is very unlikely a vixen would actually abandon her kits. Truly orphaned infants are rare as they require almost constant supervision, especially when they are very young (Fariha). Orphaned kits usually were not actually abandoned by their mother, but most likely wandered too far away from their dens and couldn't find their way back home (Fariha). Even baby foxes hand raised by humans are not ideal to keep as pets. Once they reach about 10 weeks old, they become afraid of all humans (Macdonald 1987). The only exception being the people who raised them (Macdonald 1987). They also maintain their predator instincts and will hunt even if they are kept well fed. A fox living within a home can pose a great danger to domestic birds (Francis 1906). They will, however, form bonds with domestic cats and dogs, even ones bred to hunt them.

There is one line of truly domesticated foxes created by Dmitry Belyayev. Belyayev was a Russian geneticist who over the course of 40-years and several generations created a kind of foxes that showed no fear of humans (Trut 1999). The foxes changed in appearance and behavior and they began to be more domestic dog than fox. They wagged their tails and licking the hands of their caretakers as dogs do. Through all this breeding, the foxes also went through significant physical changes. The foxes developed curled tails, floppy ears, and piebald coats. Some scientists believe the changes came lower adrenaline levels in the new foxes (Goldman 2018).

In Urban Environments

A big topic is how urban dwelling wildlife have an effect on humans and how humans, in turn, have an effect on them. Humans have greatly altered the diet, home range, and time budgets of the red foxes. Foxes, like all animals, are susceptible to a variety of diseases. A particularly dangerous disease in red foxes and other wild canids is mange. Mange is a skin disease caused by highly contagious mites burrowing into the skin. Mange is easily treatable in dogs but can be fatal to foxes due to infections. Researchers have studied how foxes move around in their environment before and after a sarcoptic mange outbreak (Baker et al. 2000) Rabies is also a disease that can be fatal to foxes. However, like domestic dogs, they can be vaccinated against it (Marks 1999). That is, researchers can find the most effective way to catch such a reclusive animal. Baiting foxes is an effective method to vaccinate them against rabies as well as reducing

the tapeworm *Echinococcus multilocularis* (Hegglin et al 2009). Researchers used various kinds of bait in order to study what kind of bait the foxes prefer. Within the first 3 days, 44 of 91 baits were eaten by foxes (Hegglin et al 2009). The rest were eaten by snails, hedgehogs, domestic dogs, and rodents.

Foxes have infiltrated urban environments in North America, Europe, Asia and Australia. They first colonized Britain in the 1930's and had established themselves well in Bristol and London during the 1940's (Urban foxes: Overview 2013). With access to new anthropogenic food sources, researchers in Australia hypothesized the foxes would be larger and in better condition than their counterparts in rural habitats (Stepkovitch 2019). The study compares the size and body condition of red foxes living in semi-urbanized areas and how they measure up to their counterparts living in rural, more natural environments (Stepkovitch 2019). They especially thrive in low-density suburbs but can live just about anywhere (Sillero-Zubiri 2004).

Humans have a long history with foxes, be it a friendly one or one of mutual distain. Through a systematic research review of legends, books, and journal articles, I am going to map how humans and foxes have evolved together.

Methods and Materials

Research Design Approach

My thesis will be structured around a systematic literature review of books and published scientific papers. To ensure what I find through the course of my research will be able to add value to my paper and help answer my research question, I will have pre-established criteria. First, I will look for published works including books and scientific papers. These with both be peer-reviewed by a number of parties and have valuable information. However, I will also be looking in non-peer reviewed works but are still valid information. For example, legends, myths, and stories are found in ancient texts that have been translated and published online. However, these stories have been circulating for centuries. This type of information I will have to review myself across multiple sources to verify the authenticity. Through a systematic review of multiple sources of information, I will be able to keep clear and focused on my topic.

I will search for scholarly articles when it applies and otherwise use a basic search to find books to review myself. I will also be using a basic search to find information that may not official enough to be peer-reviewed or be published in a book. After I have gathered all the necessary materials relating to my subject and overall question, I will then systematically extract from all the various sources, analyze it, and organize it according to my timeline or by geographical region.

To analyze data I have gathered, I will implement several organizational methods. First, the relationship between humans and foxes in a geographical manner by starting in Asia, moving to Australia and Tasmania, then Europe, Africa, finishing with North and South America. I will be analyzing all the information through a lens to either support or find the fault in a loop similar to the one described in, "*A conceptual framework to evaluate human-wildlife interactions within coupled human and natural systems*" (Morzillo et al). The loop being is an impact-based feedback loop and describes the ways human behavior is influenced by wildlife. The first way is by the sheer population level of a species in close proximity to people. The second is the type of habitat, either the availability of or lack of. Finally, there may be specific human-wildlife interactions that cause a certain emotional response (Morzillo et al). For example, farmers tend to dislike red foxes because they prey on lambs, rabbits, and chickens.

Results Mythology

Asia

The fox spirit is a common motif in East Asian mythology. The symbolism of the fox appeared to have begun in Chinese myths, and migrated to other Asian cultures. The spirit called the húli jīng or the jiuwei hu in China, the kitsune in Japan, the kumiho in Korea, and hồ tinh in Vietnam. Each has its own version of the fox spirit, but they are remarkably similar. One power they all possess is the ability to transform into people, often described as hiding among people often under the guise of a beautiful woman or young girls. The idea of interspecies transformation was born in China during the Han Dynasty (202 BC – 220 AD) by Wang Ch'ung. In a story published during the Tang Dynasty (618 AD – 906 AD), foxes could become human by wearing a human's skull, one that fit correctly, and worshipping the Big Dipper (Kang 2006). They cannot, however, disguise themselves completely. These women often have been described as having foxlike features: close-set eyes, thin eyebrows, and high cheekbones (Nozaki 1961). When the spirits have been in human form for too long, their disguise falters and they've been described as having a set of ears, tails, a coating of fine hair, a fox-shaped shadow or reflection (Hearn 2005).

All four spirits also been depicted as having up to nine-tails, with the number of tails symbolizing a variety of things. One explanation is the number of tails represents the spirit's longevity or the accumulation of energy from the sun, the moon or human breath. According to Baihutong, politico-philosophical discussions in the White Tiger Hall held in 58 CE, the nine tails symbolized abundant progeny. The nine-tailed fox is also depicted as the messenger of the goddess of immortality Xi Wangmu. A common idea between húli jīng and kitsunes is they transform once they have lived for a millennium. Guo Pu described the aging and transformation of the húli jīng, "*When a fox is fifty years old, it can transform itself into a woman; when a hundred years old, it becomes a beautiful female, or a spirit medium, or an adult male who has sexual intercourse with women. Such beings are able to know things at more than a thousand miles' distance; they can poison men by sorcery, or possess and bewilder them, so that they lose their memory and knowledge; and when a fox is thousand years old, it ascends to heaven and becomes a celestial fox*" (Kang 2006). Similarly, once the kitsune reaches 1,000 years old, it gains its ninth tale, and turns white or gold. Then it becomes a tenko ascends to heaven (Hendry 2001).

Unlike other cultures, in China the fox is morally ambiguous. Depending on the tale being told, they can be benevolent or malevolent. One of the most famous myths is the tale of Daji written in the *Fengshen Yanyi* in the 16th century by Xu Zhonglin. The daughter of a general was forced to marry a cruel tyrant named Zhou Xin. Zhou Xin had offended the mother goddess Nüwa with his lustful comments. She dispatched three of her spirits to bewitch him, the fox possessed the body of the king's concubine and expelled her soul. The spirits and Zhou Xin invented several torture devices and techniques together, turning him into a ruthless king and losing the respect of his people. Because of their actions, Zhou Xin's former generals revolted against him and the Shang dynasty. After the Shang dynasty was destroyed, the fox's spirit was driven from Daji's body by Jian Ziya, the Zhou dynasty's first Prime Minister. As the spirits fled, Nüwa appeared and condemned them for their excessive cruelty. The three women they had possessed were executed (Zhonglin). This is an example of the sly cruelty foxes have been associated with in mythology, but not all legends are the same.

In another fantasy novel first published in the 14th century, *The Three Sui Quash the Demons' Revolt* places the húli jīng in a different kind of light. The story begins when the military commander Wang Ze marries Hu Yong'er, the sorceress. Hu was taught magic by a fox spirit, which enabled her to summon powerful armies. The rest of the novel follows Wang as he joins by the sorcerers Zhang Luan, Bu Ji, and the Egg Monk Danzi Wang as they battle corrupt officials with their magic (Lou).

Kitsune is the general name for all fox spirits in Japanese myths. They were believed to be incredibly intelligent, long living, and possess supernatural powers. Kitsune are the only version of the fox spirit that used their magic to benefit their human companions. As long as the fox felt respected, they would bring their humans gifts and money, both of which often stole from their neighbors. They could also be portrayed as cunning tricksters. In medieval Japan, there was a belief a woman seen alone at dusk or during the night was believed to be a kitsune in disguise. Then there is a legend of the pearl. The kitsune's pearl represents the spirit's soul and if they are separated for too long, the kitsune dies. It is said, those who possess the pearl are able to get a wish granted from the kitsune in exchange for the pearl's safe return (Hall 2003).

Japan is the only culture that divides the kitsune into various categories. The zenko, translated to 'good foxes' are associated with the Inari, the protector of rice cultivation. They use the power they possess to ward off evil, protect shrines, and serve as guardians to locals against those spirits who don't serve Inari, the nogitsune (Hearn 2005). The nogitsune also known as the yako, literally translated to 'field foxes', are mischievous, malicious spirits (Hearn 2005). A ninko is invisible and the vilest of the fox spirits. It can only be seen after it possess a human. Finally, the tenko is the celestial fox. It is the oldest and most powerful version of the kitsune.

While the húli jīng and the kitsune are known to be morally flexible, the kumiho in Korea and the hò tinh in Vietnam are nearly always viewed as demonic spirits, meant to be feared. Kumiho were illustrated as half-fox, half-human blood-thirsty monstrosities. They wander cemeteries, dig up graves, and claw human hearts from corpses. It can also transform into other things, usually into a woman still with fox-like features, that seduces young boys in order to eat their heart or their liver. While they are able to change physical forms, they intensely guard their true identity, but people have been able to force a spirit to reveal itself. There is a poem called *The Maiden who Discovered a Kumiho through a Chinese Poem* about when a girl is revealed to be a kumiho when a dog attacks her. There is also a legend that if a kumiho doesn't kill or eat a human for a thousand days, it can become fully human. This negative image was most prominent in the Koryo Dynasty and the violence in some legends were most likely influenced by the Japanese occupation in Korea. There is, however, a collection of short stories created in the Song Dynasty (960-1279) called *Taiping Guangji* that claims people in Silla, a kingdom in the lower and central part of the Korean Peninsula, worshipped foxes, seeing them as sacred beings rather than demons. There is a fairy tale called *The Fox Sister* written in 1675, during the Japanese occupation, that depicts the evil of the fox spirit.

There is a man with three sons, and he prays for a daughter, even if she is a fox. A girl is born but when she is six years old a cow began dying every night. The oldest son was sent out to watch and he witnessed his sister pull the liver from a cow and eat it. The man accused his son of falling asleep, having a nightmare then threw him out. When the second son was sent to watch the cows on a night of the full moon, he reported the same thing to his father and was also thrown from the home. The youngest son was then sent to watch and saw his sister go to the outhouse. He told his father the cows must have died from seeing the full moon.

The two older brothers wandered the country until they had met a Buddhist monk. The monk gave them a blue bottle, white bottle, and red bottle. When they came back home, they found their sister alone in the house. She told them their parents and the youngest brother were dead. She begged them to stay and made them dinner. In the middle of the night, the older brother woke up to sounds of chewing. He rose to see his sister standing over the middle brother, eating his liver. Then she said she only needed one more liver to become completely human. The eldest brother ran, and as he did, threw the white bottle behind him. It became a thicket of thorns. The fox, however, easily made her way through it. When he threw the blue bottle, it turned into a river, trapping the fox. She easily swam ashore. He threw the red bottle and the fox was trapped in a fire. It burned her until she was just a mosquito.

The most distinctive feature of the kumiho is the 'yewoo guseul', literally meaning the fox marble/bead. The yewoo guseul grants supernatural knowledge and intelligence to any person who can steal and swallow it. However, this is how the kumiho gains power. The fox retakes the bead and absorbs the person's energy.

Similar to the kumiho, the hồ tinh is another terrifying fox monster in Vietnam. According to the legend, hồ tinh is a giant nine-tailed fox that lives deep in a cave in the mountains. The fox would disguise himself as a woman to lure travelers and villagers away, trap them into his cave, then kill and eat them. The hero of the legend is a monster hunter named Lac Long Quan. Quan tracked the monster to his cave and the fox attacked him. As the legends goes, Quan could manipulate the elements and held the monster off for three days, exhausting it. When hồ tinh could no longer fight, Quan cut off its head and then rescued several people from the cave. Then Quan destroyed the fox's den, dug Thi Hồ Trạch (Fox Corpse Pond) and built a temple to quell the spirit's anger.

The Middle East

Rather than being a spirit, the fox is a sacred animal in early Mesopotamian mythology. The fox also serves as the messenger of Ninhursag, the Sumerian Mother Goddess. In the 2nd century CE, the Jewish sage Mattheya ben Heresh first said, "Meet each man with friendly greeting; be the tail among lions rather than the head among foxes" ("הוה זנב לאריות, ואל תהי ראש" ("לשוועלים"). The phrase "the head among foxes" is comparable to the English phrase, "A big fish in a small pond".

There are also seven references to foxes in the Christian Bible:

"And Jesus said to him, "Foxes have holes, and birds of the air have nests, but the Son of Man has nowhere to lay his head." (Luke 9:58)

This verse refers when to a scribe enthusiastically says he would follow Jesus anywhere. Jesus then warns him with this verse, warning him about the cost of being a follower of his. The son of God is essentially homeless and relies on people to take him in as they travel.

"And Jesus said to him, "Foxes have holes, and birds of the air have nests, but the Son of Man has nowhere to lay his head." (Matthew 8:20)

The same scribe is described in Matthew. He was most likely following Jesus thinking he would share in ruling the world. But Jesus said again he wanted the scribe to understand that following him would not lead the scribe to heavenly glory but earthy poverty suffering.

“And he said to them, “Go and tell that fox, ‘Behold, I cast out demons and perform cures today and tomorrow, and the third day I finish my course.’” (Luke 13:32)

There has been debate about the meaning of what Jesus said in the verse, but it may mean everyday speech. Prophets were sometimes commissioned to publicly denounce leaders. The “fox” is used to represent someone crafty and devious. In this case Jesus called Herod a fox as Herod threatened to kill him.

“Tobiah the Ammonite was beside him, and he said, “Yes, what they are building—if a fox goes up on it he will break down their stone wall!”” (Nehemiah 4:3)

This verse actually refers to real foxes being able to leap over a wall. The verse also means the materials were bad enough and the craftsmanship is so terrible the just weight of the fox would cause the walls of the city to crumble.

“Catch the foxes for us, the little foxes that spoil the vineyards, for our vineyards are in blossom”. (Song of Solomon 2:15)

While foxes can be destructive to a valuable vineyard, this verse is more metaphorical than literal. The Shulamite woman verbalizes her love for King Solomon and then talks about the need to “catch the foxes” before they spoil the vines. The vineyard most likely means the new romance while the foxes represent potential problems in their relationship.

“So Samson went and caught 300 foxes and took torches. And he turned them tail to tail and put a torch between each pair of tails.” (Judges 15:4)

This refers to the story of when Samson took vengeance on the Philistines. He trapped 300 foxes then released them in pairs with slow-burning torches, setting their fields of grain on fire.

Africa

The Pale Fox, Yurugu, is a male spirit in Dogon creation myth. He is a trickster, unnatural and known to be socially disruptive, but he didn't begin that way.

In the beginning of time, there was aduno tal, the giant egg. One day it began pulsing, no one is quite sure why. On the seventh pulse the Creator, Amma, appeared. He crafted the sun, the moon, and the stars from clay and threw them into space. Then he began creating spirits in the shape of two sets of twins, each one male and female. However, the first set was wrong, so the male was born first and without his female twin. As he broke from his egg, a piece flew off into space then became the Earth Mother. This lone male was Yurugu and he was jealous of Amma's creation, so he went to Earth to make it better than heaven. He left with kize-uzi, the fonio seed, which he was going to use to sow the earth with. Unfortunately, the ground was dark and dry. The Pale Fox then went back to heaven in search of his twin with the intention of bringing her back to earth with him. Amma was so furious with the Pale Fox, he banished him to wander the desert alone searching for his twin. As time continued the creator spirits, the Nommo twins, were born as the Pale Fox should have been, representing all twinned things of the universe: male – female, right – left, order – disorder, high – low, odd – even, good – evil. They cloaked the Earth in green with cosmic fibers. The Pale Fox was also jealous of this new power, so one day he stole heavenly fibers from her skirt. Since that day Yurugu has had the power to speak.

Amma believed his son still meant to ruin the Earth, so he created four more sets of twins, the spirits who would become the ancestors of mankind. They would live on the Earth according to Amma's plans and restore the imbalance of his son's evil. The eight ancestors came to heaven for their instructions, their special knowledge, and the grain seeds. After receiving his instructions, one stole a piece of the sun. Nommo tried to stop him, but he made it to the earth, bringing the first fire. Amma's granary fell to the ground behind him, broke, and spilled vegetables, animals, and people all over the world. It took twenty-two years in order for Amma and Nommo to balance the universe. The Dogon live according to Amma's plans building their home and laying out their fields to mirror the spiral of the cosmic egg. However, when they want to know what Amma has planned for them, they ask the Pale Fox. Men would hike to the hillsides then draw a fortune slate in the sand. In the morning, they would return to interpret the fox's footprints regarding their fates (Farrell 2018).

The Pale Fox remains the mysterious agent of disorder because he is still anti-society, anti-law, and the disobedient son of the creator. However, he is also a symbol of loneliness because he still searches for his twin.

Europe

During the Middle Ages and through the Renaissance Era foxes were often associated with dishonesty and occasionally burned because people believed they were symbols of the Devil (Benton 1997). The European story that established the fox as a deceitful creature were the poems, *Ysengrimus*, by Nivardus from 1148-1153. The collection features Reynard the Fox, the anthropomorphic red fox. In the stories he's in, he is usually deceiving other animals and avoiding consequences. His main adversary and his favorite victim is his uncle, the wolf Ysengrim. He reappeared again in Pierre Saint Cloud's *Le Roman de Renart*. In the mid-13th-century a Dutch version of Saint Cloud's story was published by Willem die Madoc maecte called *Van den vos Reynaerde*. Between 1387 and 1400, a collection of stories was published in England. Geoffrey Chaucer's *The Nun's Priest's Tale* uses Reynard material where the fox is renamed "Rossel". Several versions of Reynard have been published in stories up until 2017, inspired a dozen of movies and television shows including Disney's Robin Hood and is the subject of several songs with the latest one released in 1999.

In Russian and Bulgarian folklore Kuma Lia (Godmother Fox) is a vixen who plays the role of the trickster. Her opposite in Kumcho Vulcho, the wolf, who often is the victim of her tricks. In Scotland, the fox is also a trickster figure. However, in nearby Ireland the Celts honor the fox for its wisdom and intelligence. They realize the fox knows the forest more intimately than they do and rely on it to be their guide in the spirit world. In a more magical sense, when a fox appeared the Celts believed it symbolized the need for quick and strategic thinking to adapt to a situation. It also meant to observe one's surroundings without being noticed yourself. It also has one thing in common with the kumiho and the kitsune. The fox is said to have a magical pearl, which will bring good luck to anyone who can find it.

In Greek mythology, there is a story about the Teumessian Fox or the Cadmen Vixen. The Fox had been sent by Dionysus to prey upon the children of Thebes as punishment. Creon was the Regent of Thebes and he tasked Amphitryon with catching and killing the monster. Amphitryon commanded the magical hound Laelaps. The dog was destined to catch everything it chased, and the fox was destined to never be caught, locking them in an eternal chase. Zeus faced with the paradoxical nature of their abilities turned them both to stone. They were then cast into

the sky where they remain as Canis Major (Laelaps) and Canis Minor (Teumessian Fox) (Τευμησ(σ)ία ἀλώπηξ).

While the fox is also depicted as a trickster in Finnish mythology, he isn't evil. While he is weaker than his opposition, the greedy wolf and the brawny bear, but he always outsmarts them. The fox symbolizes victory of superior intellect over malevolence and physical strength. There is a legend in the northern most parts of Finland about the firefox and the revontulet. Tulikettu was a giant magical fox who lived in the snowy hills in far north. There was only one and it was the prize trophy of every hunter in the north. It was said anyone who could catch it would be wealthy for the rest of their life. But no one could catch it. It was faster than the wind. When Tulikettu runs, its fur brushes against the snow creating magical sparks. These sparks set the sky aflame. The Finnish word for the aurora borealis is revontulet which literally translates to "fox-fires" (Mythology of the Northern Lights).

North America

In many Native American cultures, the fox is seen as a spirit or a co-creator of the universe. Some tribes in Northern California, the Silver Fox is a wise and kind creator. With other tribes in the same region, Iver Fox is the culture hero and creator god. In the Blackfoot tribe in Alberta and Saskatchewan and the Apache tribes in the Southwestern United States, they play the same role as Prometheus. The fox is associated with the sun and said he stole fire to bring to the people of Earth. The Arapahos in Wyoming and Colorado, the Kit Fox, or the swift fox, is associated with their sacred pipe. In Northeast, Plains, and Midwestern tribes, the fox is the spirit known for its intelligence and wisdom. The spirit is said to help people and animals with their problems and on occasion punish the irresponsible and pompous.

Some Native American Tribes are divided into groups of related people called clans. Each clan has a unique symbol. The symbol can be an animal, place, or natural force. Foxes are common clan animals. The tribes with the fox as their symbol are the Creek (the clan is called Tsulalgi or Culvlke) in the Southeastern woodlands, the Menominee which originated in the Upper Peninsula of Michigan, and the Hopi in the Southwest US. The Hopi tribe used fox skins as dance regalia and as adornments during ceremonies. The Blackfoot tribe was one of the most major warrior societies called the Kit Fox Society, also known as the Swift Fox Warriors. The Anishinabe tribe of the Great Lakes and the Cree tribe spanned from Alberta to Québec. They each have a version of an animal spirit, the Fox-Woman. She is illustrated as a wise and kind elder. She's an important figure in the story of Ayas. While the details vary from region to region, but it is mostly consistent.

Ayas always ends up abandoned on a deserted island, either by his father or his stepfather. In some stories Ayas is punished for protecting his mother from abuse or a woman falsely accuses him of rape. The Fox-Woman becomes Ayas's mentor and with her help, Ayas kills several unnatural monsters and resurrects them as good animals. At the end, Ayas returns home, rescues his mother, and kills the rest of the family with fire. He resurrected the second wife's youngest child as a duck. The fire continues and consumes the rest of the world so it can be born anew. The saga ends when Ayas turns his mother in a woodpecker and himself into a crow (Native American Legends). The Silver Fox is common in a few different tribes, but it is not always the same. The fox is female in Miwok tribe while it's male in Achumawi folklore.

The fox is also nearly always the companion of the coyote and co-creator of the universe. In one legend, the fox is cunning and wise, and the coyote is the trickster. In other, he is the deceitful companion while the coyote is wise. The creation myth of the Achomawi tribe, the fox

and the coyote create the world and leave just before the arrival of man (Achomawi Creation Myth). The Yurok tribe believes the Fox stole the sun, tethered him to the sun, burning a hole in the earth. The Inuit's have a story about a fox who disguises itself as a woman who then tricks a man into marrying her and leaves after she gets offended. The fox is the deceitful companion of the wolf in a Menominee tale (Bastian 2004).

South America

In ancient Peru, the Moche people worshipped all variety of animals, including the Andean fox. They believed he was a warrior using his superior intellect to fight against his enemies instead of brute strength. There is a pyramid in Buena Vista, Peru called the Temple of the Fox. It is believed to be the first 3-D art made in the Americas and dates back to between 2000 and 2200 BC (Benfer et al 2010). The fox was illustrated in sculptures, murals, architecture and painted pottery. The fox in legend is often associated with the sky and the earth. The Andean fox constellation is well known throughout South America. The temple is built so someone could easily watch the sky and make offerings to the earth. The fox's role is often to monitor offerings people would make to the Earth, to Pachacamac, and to the apus (the lords of the sky) (Benfer et al 2010). The association between the fox and the sky originated in the late preceramic period and was a strong belief until the Incas. The Andean fox is associated with the rain, water, seasons, climate change, and agriculture from the people of the Andes, to the eastern regions of Argentina and the lowlands of Brazil. Robert A. Benfer, Louanna Furbee, and Hugo Ludeña R wrote four assertions about the fox's creation mythologies:

“(1) 450 years ago, and today, there were common elements of Mesoamerican and South American origin myths;

(2) the fox portrayed in South American myths is fundamentally different from the Mesoamerican and North American fox;

(3) but he shares some elements with his Mesoamerican counterpart, such as association with the moon and night, as befits a nocturnal animal, as well as occasional elements of the trickster fox more prevalent to the north (presumably by Europe colonists);

(4) the South American fox is still widely known to indigenous peoples across the continent and is associated with cultivated food, fishing, seasonal changes in climate, and irrigation on the one hand, and with the sky, which he visits on the other (Benfer et al 2010).”

The mythical fox is linked with the Pachacamac, the god of earthquakes. The walls of Pachacamac's temple exhibit this bond, as well as the offerings and fox idols. Similar to the Pale Fox in Africa, the Andean Fox is also represented as a male and female pair in some murals at Paloma and El Brujo. His pyramid is also built oriented with the fox constellation. From this, architects determined the fox myth was in circulation for at least 450 years in Peru (Benfer et al 2010). In the 16th century Huarochirí Manuscript, the fox once came to Earth bringing cultivated crops, marine, and other terrestrial foods. He also created irrigation fields with the people (Benfer et al 2010).

Hunting

Fox hunting is a sport that consists of the tracking, chasing, and killing of a fox, usually a red fox. The hunting party usually consists of the hunter, called the “master of foxhounds” leading a group of foxhounds on horseback. The earliest known instance of fox hunting was in 1534 in Norfolk, England when farmers were driving the animals from their land. When wolves were hunted to extinction in the 16th century, the English were left without a large hunting trophy and foxes thrived without their larger competition. In 1668 George Villiers, the Duke of Buckingham, organized England’s first fox hunt in Blisdale, Yorkshire (Johnson). With the budding Industrial revolution, people began moving from the country to growing cities. Roads, railroads, and canals fractured the countryside, but hunting was more popular than ever because of the improvements made to the shotgun. In 1753, Hugo Meynell, the father of modernized foxhunting, began breeding foxhounds. These dogs were specially bred for their speed, their stamina, and their highly developed sense of smell (Johnson). Hunting with hounds was subsequently banned in Germany in July 1934 by Nazi Commander Herman Göring. The ban was extended into Austria after they were annexed in 1939. Despite this, fox hunting was more popular than ever, leading a severe decline in populations. Thus, red fox began being imported from France, Holland, Sweden, and Germany.

Robert Brooke was the first man to import foxhounds into the United States, bringing in his own pack and his horses to Maryland in 1650 (American Foxhunting). By the early 1700’s, foxhunting began to rapidly increase in popularity in the colonies. In 1747, the first hunt was organized by Thomas, the Sixth Lord Fairfax, in Virginia. The first established hunting club in North America was the Montreal Hunt in 1826. The Piedmont Foxhounds was established several years later in 1840 (American Foxhunting). The biggest difference between American and English foxhunting is what each culture believes is the best part. Americans preferred the chase rather than the kill as the English do. Foxe populations are extremely high on the British Isles because they do not carry rabies. The goal is to kill them off. Fox populations are healthier in the US due to their larger predators and other means of natural selection. In the States, the hunt ends, when either the dogs drive the fox into its den, lose its scent, or occasionally spend the hunt attempting to locate a fox (American Foxhunting). The fox lives to be chased another day.

There is no species of fox native to Australia, but they immensely damaged the wildlife there when they were introduced in 1855 for the sole purpose of being hunted (Eastham). By 1905, foxes had spread from where they were introduced on the southeastern coast to western Australia. Today there are over five million foxes in Australia and is one of the most widespread feral animals, alongside cats (Eastham).

In the UK today, foxhunting is much more controversial. Anti-hunting campaigners believe it is “cruel and unnecessary”, leading to a government inquiry in 1999 (Johnson). While the incident report notes using dogs in the hunt compromises the fox’s welfare. Foxhunting was banned in Scotland in 2002. The Hunting Act passed in November 2004 which outlawed the use of packs dogs in hunting, meaning three or more, in England and Wales beginning in February 2005 (Johnson). Despite these bans, hunts and memberships have increased. The Masters of Foxhounds Association (MFHA) currently has 176 active foxhound packs in England and Wales and 10 in Scotland.

Pest Control

The basis of hunting foxes in the UK stemmed from the need for population control, where it is considered vermin. Some farmers fear the fox preying on their smaller livestock, like chickens, rabbits, and lambs. To others they control the rabbits, voles and mice that eat their crops. Another reason farmers dislike foxes is they exhibit a common predator behavior called surplus killing. A few species known to have this behavior include damselflies, weasels, spiders, brown bears, foxes and raccoons, to name a few. Surplus killing means these animals will kill more prey than they could possibly eat at once. Unlike most animals that overkill, foxes save it for later. Arctic foxes do this with snow geese eggs and chicks during the summer. The fox will snatch and bury several eggs at once to prepare for the birth of her kits. Once the kits and the chicks are born, the fox kills multiple chicks and stashes them in order to feed herself and her young. In both Britain and Australia, there is no scientific evidence to show hunting is an effective method of controlling fox populations, as more are killed on the road. They rely on poisoning, fencing, and shooting to control populations in Australia (European Red Fox).

Fur Trade

Before Europeans colonized Canada and the United States, Russia was the supplier of fur to Western Europe and parts of Asia. The most popular pelts were hare, squirrel, beaver, marten, wolf and red fox. When Russians began settling in Siberia between the 16th and 18th centuries, they expanded to lynx, sable, otter, weasel, and Arctic fox. They then expanded into Alaska in search of other fur sources and they found the northern fur seal. Until the 19th century, Russia was the biggest supplier of fur in the world. Fur trade in America began in the 1500's and was the earliest point of contact between the Europeans and the native people of Canada and the United States. They would often trade European metal tools for the native's worn pelts. The most popular in France and England was the beaver pelt, later turned into beaver felt hats. The pelts of red foxes were most commonly used in scarves, jackets, coats, muffs as well as trimmings for coats and wraps (Bachrach 1953). Silver-morphs fox pelts were more common as capes (Bachrach). The extremely rare cross fox pelt was used for scarves. Silver was the most demanded and most valuable fox pelts to traders, followed by cross then red foxes. Red foxes found in northern Alaska were especially valued because the outermost layer of their fur was silkier than their European counterparts (The Fur Trade). The exception to this is the fur of the foxes in Alaska's southern coast. They had extremely coarse pelts. In the early 20th century alone, 1,000 fox skins were imported to Britain on an annual basis. Nearly 500,000 pelts are exported from Russia and Germany annually (Bachrach 1953). Fox pelts amount to 45% of pelts caught in the United States, worth up to \$50 million.

Today, animals are raised on fur farms instead of being trapped for their pelts. There are about 400 fur farms across the United States (Eggers 2002). Kits are born in April or May, then weaned from their mother between six and eight weeks. They are then housed in pairs until they reach adulthood. The American Veterinary Medical Association and Fur Commission USA, lethal injection is the approved and most humane method (Eggers 2002). Fox fur production is relatively small in the United States. Only about 10,000 pelts are produced in 10 states, as opposed to mink farmers which produce 3,000,000 pelts in 31 states (Eggers 2002). Canada's fur trade contributes a billion dollars a year to their economy. The country produces fifteen times more fox pelts than the United States. Finland is the world's largest producer of fox pelts, with 2.4 million produced in 2016. They accomplish by producing "supersized" foxes weighing nearly 40lbs, five times their natural weight (Wilkes 2018).

Domestication

Red foxes are similar to small dogs, with the tame Russian foxes weighing up to 20lbs, standing only 22 inches tall, and living for up to 14 years in captivity. In the United States, 14 states allow the possession of red foxes, 13 allow fennec foxes, 11 require permits to own a fox of any species, and 15 allow some type of fox with or without a permit (Smith). There are often different rules for native and exotic foxes. Native species are the red fox, gray fox, and kit fox. The exotic species are the fennec fox, the arctic fox, swift fox, bat-eared, and the corsac fox. Nebraska is one of the states that allows ownership of a fox. All species are allowed but permits are only required for native species. Nebraska also requires a Captive Wildlife Permit for red and gray foxes. However, the permit is only for captive bred animals. Exotic foxes are legal without a permit (Smith). However, kits are high maintenance, require constant supervision and need milk every four hours day and night. Once weaned, they can become destructive and fearful of nearly all humans, except for their handler.

While people have been known to catch wandering kits and keep them, there is one line of truly domesticated line of silver foxes developed by the Russian geneticist Dmitry Belyayev. Belyayev was fascinated by the diversity of dog breeds and the differences in their anatomy, physiology, and behavior. Belyayev's hypothesis was that "all domesticated species had been selected for a single criterion: tameness" (Hare 2013). After he noticed how domestic animals were different from their wild ancestors, he also hypothesized "the anatomical and physiological changes seen in domesticated animals could have been the result of selection on the basis of behavioral traits" (Goldman 2010) He believed that tameness was the critical factor. Genetics was banned in 1948 because it was a "a bourgeois pseudoscience" according to biologist and agronomist Trofim Lysenko. Lysenko was against genetics and other science-based agriculture. The punishment was swift. Over 3,000 biologists were imprisoned, fired or executed when they tried to oppose "Lysenkoism." Belyayev's brother, a geneticist, was arrested by the secret police and executed. At first this experiment began in 1959 and was disguised as a commercial fox farm. Silver foxes were valued for their fur, but instead of choosing foxes based on physical traits were chosen on one behavioral trait. Lyudmila Trut was chosen to be the manager of the project. In 1952 she chose the tamest foxes from fur farms in Estonia. The project began with 30 tods and 100 vixens. To ensure the tameness was due to genetics rather than their environment, the foxes were not trained and had only brief interactions with humans. Belyayev had strict guidelines for the breeding.

"Starting at one month of age, and continuing every month throughout infancy, "the foxes were tested for their reactions to an experimenter. The experimenter would attempt to pet and handle the fox while offering it food. The pups are tested twice, once in a cage and once while moving freely with other pups in an enclosure, where they can choose to make contact either with the human experimenter or with another pup. The test is repeated monthly until the pups are six or seven months old. The experimenters noted whether the foxes preferred to spend time with other foxes, or with humans" (Goldman 2010).

After a fox reaches seven or eight months, they had a final test and assigned a tameness score. Several factors went into this score, one of which was the tendency "to approach an experimenter standing at the front of its home pen" and "to bite the experimenters when they tried to touch it" (Trut 1999). They began with three classes of tameness. Class 3 meant the least domesticated, Class 2 foxes allowed themselves to be pet and handled but did not respond well to other contact, and the friendliest foxes were categorized as Class 1 (Trut 1999). After six generations, they added Class IE, the domesticated elite. These were foxes that began seeking out human contact, often whimpering, sniffing, and licking to attract attention at just one month old. 35% of the 20th generation was elite, 70-80% in the 30th generation (Trut 1999). In the fourth

generation born in 1963, a male named Ember was the first to wag his tail when his caretakers approached.

The foxes also experience reproductive changes. By 1962, females went into proestrus in October and November, rather than their normal period in January and March. However, males weren't ready to mate in October. In 1976, the tamest foxes than began mating in late December, gave birth, then mated again in March or April. Physical changes began appearing in the 10th generation, 1969. A female kit named Mechta had had floppy ears well past when they were supposed to straighten out at two weeks old (Dugatkin, Trut 2017). When Belyayev came to visit her when three months old, her ears were still floppy. Also in the 10th generation, a male had the first truly piebald coat and the very first white patch in the middle of his forehead (Dugatkin, Trut 2017). Shortened tails widened skulls and tails rolled over the foxes' backs were also reported in this generation. After 40 generation and 45,000 foxes, they had "floppy ears, short or curly tails, extended reproductive seasons, changes in fur coloration, and changes in the shape of their skulls, jaws, and teeth. They also lost their 'musky fox smell'" (Trut 1999). They were also eager to please, tolerated leashes, and learned to fetch and sit.

In Urban Environments

Foxes are one of the most successful infiltrators of urbanized environments. Today they have established populations in several Australian, Japanese, European, and North American cities. The first known occurrence of foxes living in a city was Bristol in the 1930's, then London suburbs in the 1940's followed by Cambridge and Norwich (Urban foxes: Overview). In the 30's, foxes were first recorded in Melbourne, Australia. By the 1980's, they were beginning to appear in Zurich, Switzerland. The last population estimate in urbanized Britain was taken back in the 80's, with 33,000 adults. In 2006, there was an estimated 10,000 foxes in London ("10,000 Foxes Roam"). Major cities with a fox population include Paris, Berlin, Oslo, Toronto, Los Angeles and New York (Urban foxes: Overview).

Mange is dangerous disease in red foxes and other canids. Mange is a skin disease caused by high contagious mites burrowing into the skin. Mange is easily treatable in dogs but can be fatal to foxes due to infections. Researchers have studied how foxes move around in their environment before and after a sarcoptic mange outbreak (Baker et al. 2000) Rabies is also a disease that is fatal. If caught, they can be vaccinated against it (Marks 1999). The most effective way to catch a fox is called baiting, essentially laying a trap for the fox. City-dwelling foxes are a bit different than their rural counterparts. They are slightly bigger because of the abundance of anthropogenic food and the lack of predators (Stepkovitch 2019). They are still crepuscular, meaning they are active at dawn and dusk. Usually they hide in undisturbed areas then venture farther into the city for food at night. Some people have been known to leave food out, drawing foxes (and other animals) to their homes.

Discussion

The feedback loop created by Morzillo, de Beurs, and Martin-Mikle can be used to explain all variety of human-wildlife interactions (*Figure 1*).

Relationships described in the text are as follows:

- (a) a wildlife related event plus a human reaction results in an impact;
- (b) impacts can influence human behavior;
- (c) individual human characteristics can influence reactions and behaviors;
- (d) human behaviors serve as drivers of wildlife management and policy;
- (e) human behavior resulting in an impact could have direct
- (f) indirect feedbacks that affect wildlife;
- (g) changes to the landscape as a result of human behaviors occur across multiple scales;
- (h) land use affects landscape characteristics;
- (i) environmental policy limits human behavior for the benefit of humans and other species.

Letters a-d correspond to impact- based feedbacks. Letters e-g correspond to behavior-based feedbacks. Letters g-i correspond to landscape-based feedbacks. Letters a-c correspond to components and feedbacks are considered parts of the “human system” while and g-h are a part of the “natural system,” D-f and i represent the links between them. An impact, either positive or negative, is the result of a wildlife-related event that causes a human reaction and then results in a particular human behavior. For example, foxes began preying on small livestock, which caused people to view them as vermin, then the organized fox hunt was born to deal with the fox population. All human-wildlife interactions can be described with this chart, both good and bad interactions, resulting in a positive, negative, or neutral relationship between the two species. Humans and red foxes specifically have managed to have all three kinds of relationships simultaneously.

Conclusion

In conclusion, relationships are complicated, particularly long ones. The original question is, to what extent has the relationship between humans and foxes evolved? The short answer is considerably. The legendary fox spirits of China date back to the Han Dynasty, between 202 BC – 220 AD. Through the eyes of humanity, the fox has morphed from creatures of nightmare, worshiped gods, and spiritual guides into an animal people can wear around their shoulders, hunt from horseback, and walk on a leash. No two foxes are the same, just as no two people are the same. A person who owns a playful domesticated Siberian fox feels much different than someone who must protect their rabbits from a crafty predator.

To improve upon this research, there are a few more topics I would have liked to explore. One of which being how foxes have influenced pop culture, especially in the media. Reynard the fox from Ysengrimus, the poems by Nivardus, inspired many other stories and even the animation style used by Disney when creating Robin Hood in the 70’s. Finally, I would have liked to research the

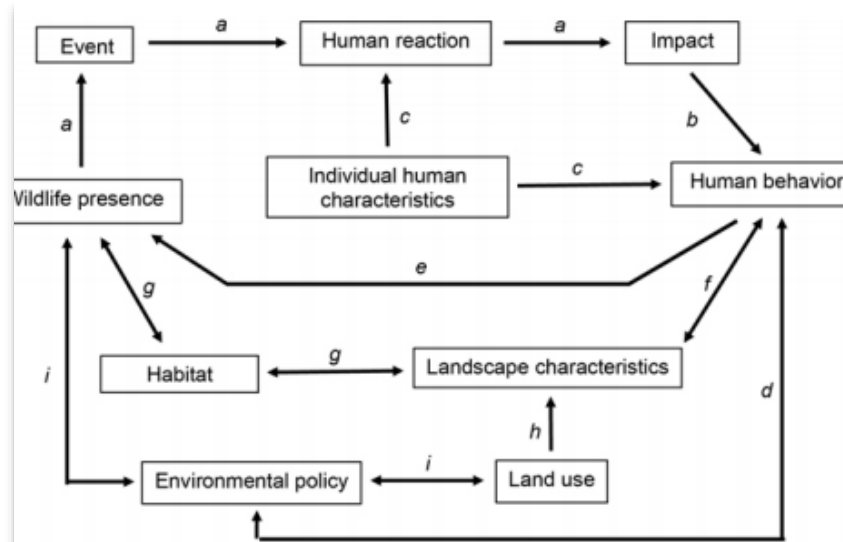


Figure 1

controversy surrounding both fur farms, particularly in Finland, as well as hunting and trapping controversies.

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Τευμησ(σ)ία ἀλώπηξ (*Teumēs(s)īā alōpēx*), *gen.*: Τευμησίας ἀλώπεκος, also known as ἀλώπηξ τῆς Τευμησοῦ "fox of [Teumessos](#)"